The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

NOVEMBER 1885.

CONTENTS:

By faith we understand that the worlds have been framed by the word of God, so that which is seen hath not been made out of things which do appear.

ARTICLES:— Page.

Commensurability of Motions. DANIEL KIRKWOOD..... 257
Small vs. Large Telescopes. W. F. DENNING..... 259
Sun-spots for September. R. HENRY FERGUSON..... 261
GALLE'S Catalogue of Comets from 1860 to 1884. W. C. WINLOCK..... 264
Stellar Photometry. HENRY M. PARKHURST..... 273
Variation in the Nebula of Andromeda. W. H. NUMSEN..... 278

EDITORIAL NOTES:—

The New Star in the Nebula of Andromeda.—Observations of the New Star by Professor C. A. YOUNG.—Photographing the Corona by Dr. HUGGINS and Prof. W. H. PICKERING.—Parallax of 61 Cygni.—Brightness of the New Variable by J. G. HAGEN, S. J.—Occultations of the Hyades by JOHN TATLOCK, Jr.—The New Star by H. A. PAVEY.—Professor E. S. HOLDEN'S Letter Concerning the Lick and Washburn Observatories.—Weight of Large Object Glasses..... 280—288

The Messenger will be published monthly except for July and September. Subscription price per year (ten numbers) $2.00. Communications should be addressed to the Editor, Northfield, Minnesota.

NORTHFIELD, MINN.

CARLETON COLLEGE OBSERVATORY.

Entered at the Post Office at Northfield, Minn, and admitted for transmission through the mails at second-class rates.

Drawing and Painting.

A gentleman who is widely known in the United States, and has had the advantages of thorough art studies in one of the best schools in Germany desires a position as

Teacher of Drawing and Painting

in some collegiate institution.

This artist has extended acquaintance in the Cities of the East, and references for quality of work can easily be obtained

For particulars or further information,

Address,

SIDEREAL MESSENGER,

3 t.] *Northfield, Minn.*

SILVERED GLASS REFLECTING

TELESCOPES

AND SPECULA.

I am prepared to make the above nstruments at most reasonable rates. The specula are of the best quality, being tested and corrected by a modified form of Foucault's method. The plane mirrors are tested and corrected by Dr. Hastings' process, and are warranted correct. The telescopes are all mounted equatorially unless otherwise desired. Specula made for those who desire to mount their own telescopes. For testimonials and further information, address

J. A. BRASHEAR,

No. 3 Holt Street, Pittsburgh. S. S. Penna

DIFFRACTION GRATINGS.

Professor Rowland of the Johns Hopkins University has placed in my hands the distribution of the fine gratings ruled on his engine. The plates are ruled with 14,438 lines to the inch. Five sizes are ruled, viz. 1 inch 1½in, 2 in, 3 in, and 5 in. For full information, address

J. A. BRASHEAR, PITTSBURG, S. S. PENNA.

The Sidereal Messenger

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 4. NO. 9. NOVEMBER, 1885. WHOLE NO. 39.

COMMENSURABILITY OF MOTIONS.

BY DANIEL KIRKWOOD.

(For the Messenger.)

With respect to the proposed explanation of the observed intervals in the ring of *Saturn* and the zone of minor planets, Professor HALL remarks:*

"Gaps in the ring of asteroids, and divisions in the ring of *Saturn* have been explained on the theory that it is impossible for bodies to move in such places, since their motions would be commensurable with those of certain planets or satellites."

In assigning a physical cause for the gaps in *Saturn's* ring I have never considered the question of stability independently of collisions. I have simply shown [1] that the matter which originally moved where the intervals are now observed was liable to extraordinary perturbation; and [2] that as the rings have considerable density the disturbed portions would be brought in collision with either the exterior or interior parts of the ring, thus eliminating the primitive matter from the belts of greatest disturbances. A body revolving as a satellite in any part of the greater interval would be brought in contact with

* Sidereal Messenger, Sept., 1885, p. 201.

the outer ring before its eccentricity could become equal to 0.012. This is less than the observed eccentricity of some of the satellites.

The same reasoning is applicable to the zone of asteroids; but the small comparative density of the latter would render collisions relatively less frequent.* In this case, however, a cause somewhat different is equally apparent. The disturbed orbits of the minor planets would attain considerable eccentricity so that the matter moving in them would, in perihelion, be brought in contact with the equatorial parts of the solar mass, and thus become reunited with it. The origin of gaps, therefore, is not referred to the commensurability of periods as the simple or only cause. The fact, however, that such chasms occur precisely where the periods have such relations is too obvious to pass for an accident. The gap, for example, where an asteroid's period would be half that of *Jupiter* is 0.1393 in breadth. The number of asteroids, as has been elsewhere shown, in the belt of equal extent immediately interior is 37. The probability that this fact should be due to a chance distribution is as 1 to 137,438,953,472.

The writer's explanation of these remarkable gaps, proposed nearly twenty years since and frequently re-stated, does not necessarily require that the chasms in question should be absolutely void. Some portions of the primitive matter might, under peculiar circumstances, escape precipitation. It is to be observed, moreover, that orders of commensurability higher than the third could hardly be expected to produce well-defined intervals.† Adopting this limit, we have only the distances, 2.50 2.82, 3.27, 3.58, 3.70 and 3.80; at all of which chasms are very distinctly marked. The distance 2.70, where three periods of

* Monthly Notices, Vol. XXIX, p. 101

† The order of commensurability depends upon the difference between the numerator and denominator of the fraction expressing the ratio: Thus ½ or ⅔ is the first order, ⅓ or ⅗ is the second, ⅖ is the fifth, etc. The frequency of conjunctions during the number of Jupiter's revolutions contained in the numerator is indicated by the order of commensurability.

Jupiter are equal to eight of an asteroid, is of the *fifth* order, and consequently the conjunctions would occur at five different points around the ecliptic. The fact that the mean distances of several minor planets differ but little from 2.70 has been thought unfavorable to the view that the chasms are produced by *Jupiter's* action. The facts are as follows: The average of seventy-nine adjacent intervals [between 2.6 and 2.8] is 0.002,113. The interval 0.011020, between *Hera* and *Olympia* where an asteroid's period is three-eights of *Jupiter's*, is not only greater than any of this number, but is more than five times the average.

The mode in which gaps were produced by disturbing causes has been here indicated, I trust, with sufficient clearness. The statement that *Jupiter's* action, alone, independently of collisions, may have changed the mean distances of certain asteroids* is unnecessary as well as doubtful. It was made without investigation on the authority of HUMBOLDT. Among the chief elements of stability this eminent writer includes the fact "that the periods of the planetary revolutions have among each other no common measure."† From this view Mr. PROCTOR at once dissented, while admitting the correctness of my principal explanation.‡

* Monthly Notices, vol. XXIX, p. 100.
† Cosmos, Vol. IV, Bohn's Ed., p. 600.
‡ Intellectual Observer, Vol. IV, p. 23.

SMALL VS. LARGE TELESCOPES.

W. F. DENNING.

(For the Messenger.)

With reference to the letters on this subject, recently published in the *Observatory* and Mr. BURNHAM'S comments thereon in the SIDEREAL MESSENGER for September, I wish to say that your correspondent has quite misunderstood the point at issue. The basis of the discussion [see *Observatory* for March,

p. 79] was the relative value of small and large telescopes in showing detail on a bright planet. Mr. BURNHAM says the discussion has been "on the comparative value of large and small apertures for showing planetary details and other faint celestial objects "[! !] and proceeds to argue the point in relation to double-star observations. This is quite irrelevant to the special question in hand, and I may add that his denunciation of reflectors is equally unnecessary. No one has questioned the superiority of large apertures for double-star work, but with bright planets the conditions are very different.

I have pointed this out in a communication to the *Observatory* and there seems little need for one to discuss the matter further on the new basis introduced by Mr. BURNHAM. But I am sorry to find the *intention* of my remarks has been misconstrued. From the tone of certain criticisms it would appear that I had specially attacked the large refractors of ALVAN CLARK & SONS. I am sure that anything I might say in disparagement of these justly celebrated instruments would carry very little weight. My statements have applied to large telescopes generally, and I incidentally referred to the large refractors at Washington, Princeton and Chicago because they have been actively employed on planetary work, and the published results afforded the means of gauging their capacity in this respect. I did not speak of the large English refractors as they are only heard of indirectly about once in ten years! COOKE's 25-inch mounted at Galeshead has been found practically useless, the climate being so bad, and Mr. BUCKINGHAM's 21¼-inch at London has not been mentioned since January, 1870! In initiating the recent controversy in the *Observatory* I had no thought of deprecating American instruments or work. Every man who has any regard for astronomy and has watched its progress of late years must feel a sincere and undisguised admiration for what has been accomplished in the United States.

In concluding I may add that Mr. BURNHAM is not justified in twisting Prof. HALL's perfectly candid expression of opinion

to suit his own views. Let any one read Prof. HALL's letter in the *Observatory* for May, p. 174, and see if it will bear the construction put upon it by Mr. BURNHAM. Nothing could be more intelligible and concise than the words of the eminent astronomer of the Naval Observatory. As to Mr. BURNHAM's sneer at the planetary detail observed in small telescopes, it is evident he is far from entertaining a fair opinion on the subject. Should he ever be led to study the bright planets by means of one of WITH's or CALVER's silvered mirrors he will be rather astonished to see with such distinctness many of the features which are described as very difficult objects in much larger instruments, and possibly his keen and practiced eye may reach a marking, which, though of absolute existence is obliterated in the glare from very large object glasses and specula. If he is so successful he must clearly understand it is a mere deception arising from small aperture.

BRISTOL, ENGLAND, September 16, 1885.

SUN-SPOTS FOR SEPTEMBER.

R. HENRY FERGUSON.

(For the Messenger.)

The *Sun* has been observed throughout September each day except seven when clouds, or necessary absence from the city prevented observation.

Total number of days on which *Sun* was observed	23
" " " groups of spots	61
" " " spots	113
Probable total number of spots; i. e. calculated to include days when the *Sun* was not observed	70
Probable total number of spots	125
Largest number of groups, on the 3d, 4th, 5th, 26th	5
" " " spots on the 3d	13

On the 20th no spot was visible on the *Sun*; bright faculæ on the eastern limb was observed.

Nothing of especial interest was noted this month in connection with the sun spots except the proper motion and division of the spots appearing on the 8th and 21st, respectively. The former of these which was the largest spot visible during the month showed, when first seen on the 9th, a very marked, but minute triangular tongue projecting from the penumbra into the black spot. The tongue was very white, while the penumbra at point of contact with it was quite dark, perhaps due partly to contrast. On the 10th the tongue had extended itself and could be traced across the spot as a bridge exceedingly narrow at the end just formed. On the 11th the bridge had widened, and the division was complete.

During these three days the penumbra also underwent most rapid changes. When first seen it was nearly circular (elliptical on account of foreshortening) but it soon became irregular and sent out a branch from its southern side, resembling in shape the continent of South America. On the 10th this was broken into two horns, or perhaps better, chains of penumbral patches, one horn from the southern side and one from the western, and curving near their extremities toward each other. Soon after these portions of penumbra became detached and on the 14th were invisible, the bridge at the time being very wide and paler so that the black spots were clearly two, although enclosed by one penumbra.

On the 15th the two spots had separated much wider apart, the penumbra of each still being connected though only very slightly. Observation on the 16th revealed the penumbra and spots wholly distinct, each with a nearly circular penumbra and they continued to separate rapidly until they disappeared around the limb. It will also be noticed that these spots had also a decidedly rapid proper motion westward, traversing the disk from limb to limb in less than eleven days. This spot, which was at a latitude of nearly 20° should have taken nearly

12*d* 21*h* in crossing if it had the average motion of spots at that latitude.

The spots which appeared on the 21st exhibited on the 25th and succeeding days much the same phenomenon. On this latter date a white tongue appeared, and on the 28th the bridge was complete although the penumbra shows as yet no signs of division.

A peculiar phenomenon was noticed in connection with the spot first seen on the 3rd. On the 4th there appeared a very black, wedge-shaped tongue connected at its base with the umbra, extending eastward, dividing the penumbra, and for several seconds projecting into the bright surface of the *Sun*. On this latter portion no penumbra could be detected, the dividing line between the dark and bright being very sharp and abrupt.

THE ECLIPSE OF SEPTEMBER 24TH.

The eclipse which began here in contact with the penumbra at 23*d* 12*h* 05*m* "standard time" was observed and several features noticed. The brownish red border to the shadow was not seen, although carefully sought, the penumbra being very dark and clearly seen ten minutes after the time for first contact. The umbra was of an ashy blackness and wholly obscured all lunar configuration which it covered, and at the point nearest central shadow the limb of the *Moon* was so obscured that its outline could only be traced in imagination by continuation of the eastern and western limbs slightly visible. In the eclipse of the autumn of 1883 the writer could observe with ease all the more prominent markings of the *Moon*, although immersed in the brownish red shadows. On the 23rd, however, even Petavius and Tycho were much obscured by the penumbra. The night was remarkably clear. Observation was discontinued at 3 A. M. just after middle eclipse.

A BRIGHT METEOR.

Sept. 28th at 6*h* 45*m*, while returning from the post-office a very bright meteor, surpassing *Sirius* in brilliancy, darted slowly

from *Aquila* and became extinguished near *β Herculis*. It appeared suddenly, though not with its full brightness, which it soon gained and retained until it went out instantly. No train of light could be seen. It looked like a white hot ball, not like ordinary meteors as a hard substance being consumed.

Yesterday I received the following communication from St. Johns, Newfoundland:

"On September 24th appeared an unusual phenomenon in the north-west. A huge red meteoric body rose over Conception Bay, and within seven minutes traversed an arc of between thirty and forty degrees."

NEWTON CENTER, MASS.

GALLE'S CATALOGUE OF COMETS FROM 1860 TO 1884.

[The following catalogue of more recent comets is from Dr. J G. GALLE's "Uebersicht ueber die Bahn-Elemente der seit dem Jahre 1860 erschienenen Cometen, sowie ueber neu berechnete oder verbesserte Bahnen von Cometen der frueheren Zeit," contained in Nos. 2665 and 2666 of the *Astronomische Nachrichten* (vol. 112, 1—26), omitting his list of newly-computed orbits of comets earlier than 1860. The signification of the symbols, T, π, Ω, etc., has been inserted for convenience, and in the references to journals the volume (in Arabic numerals) and page, separated by a colon are generally given. W. C. W.]

The list of comets given in the third edition of "Olbers' Methode zur Berechnung der Cometenbahnen" ends with the year 1863, and for several years I have desired to bring together the additions which have accumulated since that time, together with the list of 1847 and the supplement of 1864,—into one newly-arranged catalogue: I have not thus far, however, been able to carry out my scheme as planned. In the meantime, on account of the great number of new comets, there has appeared to be a real need of such a list, and a wish expressed by the editor of this journal *[Astron. Nachr.]* has induced me to compile, as a temporary substitute, a brief synopsis of the newly added comet orbits, following in its tabular form the list of 1864.

Our limited space allows for each comet merely the approximate data from a single (if possible, the latest) orbit, and the remarks are restricted to the reference for this orbit, the date of discovery, the duration of visibility, and a few other notes, principally brief remarks on the orbit given.

The headings, T, π, Ω, i, log q, e, in the table are those commonly used, and correspond exactly with the list of 1864, except that the column "mean motion," as it is called, has been omitted.

T=Paris mean time of perihelion passage.
π=Longitude of the perihelion.
Ω=Longitude of the ascending node.
i=Inclination of the plane of the orbit to that of the ecliptic.
log q=Log. perihelion distance.
e=eccentricity.

The distinction between direct and retrograde motion (D and R) is, also, for the present retained. In retrograde orbits we readily change from one system of reckoning, π, i, to the other, π', i', by means of the relations

$$\pi+\pi'=2\Omega$$
$$i+i'=180^\circ$$

and it is only necessary to remember that the distance, ω, of the perihelion from the node in the retrograde reckoning is not $\pi=\Omega+\omega$, but $\pi=\Omega-\omega$.

The comets are arranged strictly in the order of their perihelion passage. This is a long established and very natural system and one possessing numerous advantages: furthermore, it has lately been made the rule of the *Astronomische Gesellschaft*, so that it will require no further discussion here. The uncertainty sometimes existing in the designation of particular comets during the year of discovery can always be easily removed, for the time being, by the addition of the name of the discoverer. Moreover a strict adherence to this system of numbering comets in each year has become necessary of late, partly on account of the greater number of comets discovered, and partly on account of the considerable increase of the known

periodic comets, during the last forty years; for the actually observed returns of these comets must be arranged with the other comets. Since in many cases the periodicity has first been established at the second apparition, and in a few cases at the third, the exclusion of periodic comets from the list of apparitions of each year would frequently cause annoying changes in the designations of earlier years, and it would give rise to all sorts of ambiguity. In the publications of the past ten years, the periodic comets, particularly, have led to a great many differences in the designation of comets, an evil which is not merely of a theoretical nature, but, for those who often have occasion to refer to the literature of comets, is one which carries with it very real and practical inconveniences, frequently necessitating much troublesome comparison of observations, or of ephemerides, to decide what comet really is referred to. Especially in years in which a great many comets are seen, if the names of the discoverers are not given, there is not only loss of time, but besides this mistakes easily occur.

In the list published in 1864 this arrangement of the observed apparitions of comets in the order of perihelion passage is closely followed out to the end of the year 1863. The present supplement, however, on account of further discussion of data belonging to the years immediately preceding, I have begun with the year 1860, so that it contains the orbits of all computed comets (ninety-four in number) for the twenty-five years from 1860 to 1884.

The numbering in the first column of the table follows that of the table published in 1864. Although these numbers have no special signification here; and, as numerous insertions have been made, they ought really to be increased, still, on account of their connection with the earlier list, they have been retained. Interpolations between the earlier numbers are marked with the letters *a*, *b*, *c*, etc. The current numbers of the present list are therefore to be increased by 6+6 +4=16, so that at the end of the year 1884 the number of different comets of which orbits have been computed, is 302. The number of apparitions of comets, including the present recorded returns of periodic comets, is considerably greater:

D'ARREST'S	Comet has	been	observed	4	times.	
BIELA'S	"	"	"	6	"	
BRORSEN'S	"	"	"	5	"	
ENCKE'S	"	"	"	23	"	
FAYE'S	"	"	"	6	"	
HALLEY'S	"	"	"	7	"	
PONS'	"	"	"	2	"	
TEMPEL'S$_1$	"	"	"	3	"	
TEMPEL'S$_2$	"	"	"	2	"	
TEMPEL'S$_3$	"	"	"	2	"	
TUTTLE'S	"	"	"	3	"	
WINNECKE'S	"	"	"	4	"	

Accordingly 67−12=55 repeated apparitions are to be added, bringing up to 357 the total of the observed appearances of comets. In this summary, of course, no allowance is made for the great uncertainty of many of the older orbits, or for the fact that in some cases it is doubtful whether the *same* periodic comet has been seen.

In the table for the period since 1860 it appeared desirable to show at a glance the returns of the periodic comets in their chronological order, and to be able to find them among the comets arranged for each year strictly according to perihelion passage, without further reference. There are accordingly added to the numbers in the first column (which always refer to the first appearance of the comet) the initial letter of the name commonly in use for the comet:

D'A=D'ARREST'S comet B=BIELA, Br=BRORSEN, E=ENCKE, F=FAYE, H=HALLEY, P=PONS 1812, T_1, T_2, T_3=TEMPEL'S three comets, 1867 II, 1873 II, 1869 III, Tu=TUTTLE, W=WINNECKE. As no fixed rule for designating periodic comets has been established—and indeed none can be established without great difficulty—I have retained the designation which seemed to me to be most generally used. If other names should be preferred, the designation can easily be changed, without disturbing the numbering of the comets according to perihelion passage—the only point considered essential. TEMPEL'S three comets I have distinguished according to their periods as finally fixed by the observed returns; T_2 being the last discovered of these three comets.

It is readily seen that some rule of this sort must be used in such cases, in order that subsequent changes may be avoided.

There are since 1864 quite a number of comets which have been incompletely observed, or, at all events, for which only uncertain data are at hand, so that no orbit could be deduced. In some instances, the observations are so imperfect that no great value can be attached to the computed orbit. All such comets are found (as in the catalogue of 1864) with necessary references, among the notes for the different years.

Finally, it is to be mentioned that for the equinox to which the elements are referred, the mean equinox of the beginning of the year in question is, generally, to be understood. This plan for facilitating the comparison of comet orbits was proposed by OLBERS, and it will be recognized by astronomers as the commonly accepted rule. In the elements of some of the periodic comets where perturbations have been taken into account, the equinox of the beginning of the decade has lately been used to some extent, and in these cases, in the present table (which gives only minutes; and for all more accurate computations, reference must be made to the sources which are quoted) I have reduced the longitudes to the beginning of the year of the observed return.

The following abbreviations are used for journals frequently referred to:

A. N. *Astronomische Nachrichten.*

M. N. = *Monthly Notices of the Royal Astronomicul Society.*

C. R. = *Comptes rendus hebdomadaires de l'academie des sciences de Paris.*

A. V. S. = *Vierteljahrs-Schrift der Astronomische Gesellschaft.*

Wien. Ak. S. B. = *Sitzungsberichte der k. Akad. d. Wiss. in Wien, math. phys. Classe.*

[The reference is usually to the volume and page (or column in A. N.) which are separated by a colon. Further abbreviations will explain themselves.]

216 A. N. 72: 236. Discovered by LIAIS at Olinda, Brasil, Feb.

26, and observed by him till March 13, on seven days. Not observed except by the discoverer. The second certainly known example of a double comet. PECHULE has computed the orbits of the two nuclei separately.

217. Bull. de St. Petersb. 6: 363. From all the observations formed into six normal places, which are well represented. Discovered by G. RUMKER at Hamburg, April 17. The observations of this faint comet extend over a little more than a month, a single observation of BOND'S on June 11, excepted.

218. Schriften der Berl. Akad. 1867. Bright comet visible to the naked eye at various places in Europe from June 18, to about the middle of July; observed at Santiago to September 12, and at the Cape to October 18. The most probable orbit, deduced by AUWERS from a very careful discussion of the observations, showed no deviation from a parabola; similar result by FISCHER, A. N.: 67: 291.

219. A. N. 75: 165. Discovered October 23 by TEMPEL at Marseilles and observed there on the day following, and, also, October 25, at Paris. The above orbit rests on a new reduction of TEMPEL'S observations, and agrees very closely with a provisional computation by v.OPPOLZER (A. N. 73: 189). The orbits by VALZ, widely differing from these, are to be rejected, and an identity with an object observed on November 14 seems inadmissible.

220. A. N. 62: 187. First discovered April 4 by THATCHER at New York. Seen in Europe on April 30 with the naked eye by BAEKER at Nauen. Before perihelion, observed in the northern hemisphere (at Washington and Athens) to May 25; after perihelion by MOESTA at Santiago, July 30 to August 15; by MANN at the Cape, August 18 to September 6. The definitive orbit by v. OPPOLZER is deduced from seven normal places (April to September) and gives a period of 415.43 years. The orbit comes very close to the *Earth's* orbit—evidently connected with the periodic meteors of April 20.

221. Diss. inaug. Bonn. 1880, p. 146. This great comet at its ascending node was almost directly between the *Earth* and the *Sun*, and as the plane of its orbit is almost perpendicular to the ecliptic, it appeared very suddenly in the northern hemi-

sphere, June 29—30, in its full splendor. In the southern hemisphere it had already been discovered, May 13, by TEBBUTT at Windsor. It remained visible for a long time in the northern hemisphere — far north in declination — and could be followed (at Pulkowa) even to May 1, 1862. The definitive orbit which was computed by KREUTZ, taking into account the perturbations of *Venus*, the *Earth*, *Jupiter* and *Saturn*, required no less than 1156 observations. These were brought together in thirty-one normal places. The period is 409.4 ± 0.367 years.

222. A. N. 69: 106. Discovered 1861, December 28, by TUTTLE at Cambridge, U. S., and 1862, January 8, by WINNECKE in Pulkowa. On account of its rapid decrease in brightness it could be observed for but a short time; last observed February 2 by TIETJEN at Berlin. NOETHER has divided the few observations into sixteen normal places, and the elements agree remarkably well with those by V. FUSS (Bulletin de St. Petersb. 8) from four normals.

(96) E. Mem. de l'acad. de St. Petersb. 26 No. 2 (1878). ENCKE's comet. Found October 4 by FOERSTER at Berlin; more generally observed in November, December and January. The observations at the Cape by MACLEAR extend from December 23, 1861, to March 12, 1862.

223. A. N. 58: 141. Discovered on July 2 by SCHMIDT at Athens, and an hour later by TEMPEL at Marseilles, and also on July 3 by BOND at Cambridge, and by SIMONS at Albany. The comet, owing to its nearness to the *Earth*, looked, at first like a great nebula, even visible to the naked eye, but it soon decreased in brightness, and was observed only to July 30 (at Athens, Cambridge, U. S. and Clinton). The orbit above is from July 2, 10 and 23.

224. A. N. 59: 87. Probably first seen July 15, at Marathon, U. S., by SWIFT, who mistook it for the preceding comet [223]; more definitely located July 18 by TUTTLE at Cambridge; July 25 by P. ROSA at Rome; July 26 by SCHJELLERUP at Copenhagen. In August the comet was visible to the naked eye, moderately bright. It was observed at Athens by SCHMIDT up to September 26, and in the southern hemisphere by MANN at the Cape to October 27. From the observations

formed into six normal places, v. OPPOLZER, taking account of the perturbations of the *Earth* and *Jupiter*, found the above orbit with a period equal to 121.502 years. Closely associated with this comet is SCHIAPARELLI's discovery, in 1866, of the connection with the meteors of August 10.

225. A. N. 65: 61. Discovered November 27 by RESPIGHI of Bologna, and December 1 by BRUHNS at Leipzig. The observations before perihelion go only to December 17 (the last at Florence). After perihelion the comet was observed only twice, and with considerable difficulty, by BRUHNS. The above orbit is the most probable from all the observations divided into five normals.

226. A. N. 60: 149. Discovered by BRUHNS at Leipzig, November 30, one day before he found the preceding comet. At first, very faint; at the time of perihelion, brighter; observed by BRUHNS till March 12. Above orbit by ENGELMANN is a parabola computed from five normal places. The deviation from this curve is inappreciable.

227. Wien. Akad. S. B. 1864, A. N. 62: 343. Discovered April 11 by KLINKERFUES at Gottingen, and April 14 by DONATI at Florence. In May, visible to the naked eye; last observed November 14, at Pulkowa. FRISCHAUF has collected all the observations into eight normals, which are accurately represented by this orbit.

228. A. N. 60: 112. Discovered April 12 by RESPIGHI at Bologna, April 13 by BAEKER at Nauen, April 16 by WINNECKE at Pulkowa and TEMPEL at Marseilles, April 18 by KARLINSKI at Cracow. Last observed June 1, at Leyton, by ROMBERG. The orbit, by FRISCHAUF, is deduced from three normal places, April 18, May 7 and 18.

229. A. N. 61: 248. Discovered by TEMPEL at Marseilles, November 4, and eight days later by SCHMIDT at Athens; observed at Leipzig by BRUHNS till February 9, 1864. The elements are derived from three normal and two single places (to December 20) which are very well satisfied by the parabola.

230. Diss. inaug. Berol. 1869. Discovered December 28 by RESPIGHI at Bologna, and 1864, January 1, by BAEKER at Nauen; also January 9 by KARLINSKI at Cracow and by WATSON at Ann

Arbor. Observed at Leyton by ROMBERG to March 1. In deriving the above elements the available observations were collected into nine normal places, and they agree very closely with the parabola computed by WEISS (A. N. 61: 349) from six normal places, January 3—23.

231. A. N. 68: 158. Discovered before either of the preceding comets, October 9 by BAEKER at Nauen, and October 13 by TEMPEL at Marseilles, (Annuaire 1884). Last observed at Leipzig by ENGELMANN, April 13. The above orbit is the most probable parabola, from all the observations. A similar computation has been made by JULIUS, (A. N. 69: 6) and it gives a complete agreement with the above.

232. A. N. 73: 84. Discovered by DONATI at Florence, September 9; but few observations obtained. Last observed October 10 by ENGELMANN at Leipzig. The elements are from fourteen observations divided into three normal places.

233. A. N. 75: 164. Discovered July 4 by TEMPEL at Marseilles, July 5 by RESPIGHI at Bologna, July 11 by KARLINSKI at Cracow; last observed in the northern hemisphere at Athens Sept. 22 by SCHMIDT. In the southern hemisphere the comet was first seen August 10 at Windsor, and August 11 at Santiago by MOESTA. It was observed at Windsor by TEBBUTT till September 25, and was seen as late as September 27; also seen September 26 at the Cape, but extremely faint. The elements are derived from seven normal places.

234. A. N. 66: 123. Discovered July 23 by DONATI and TOUSSAINT at Florence; observed in the northern hemisphere till the middle of August (at Leipzig by ENGELMANN to August 13) and then in the southern hemisphere, from November 2 to December 23 by MOESTA at Santiago. On its return to the northern hemisphere it was found again by SCHMIDT at Athens, January 19, 1865, and observed to January 30; last observed February 24 by PETERS at Clinton. The elements are deduced from six normal places, and take account of the perturbations of *Jupiter*.

235. A. N. 73: 90. Discovered by BAEKER at Nauen December 15; also by CHARCORNAC at Marseilles December 19, and by RESPIGHI at Bologna December 29 (Ann. 1884); last observed

by STRASSER at Kremsmunster. Most probable orbit from seven normal places.

236. A. N. 68: 119. Discovered December 30 at Leipzig by BRUHNS; last observed January 29, 1865, by BRUHNS and ENGELMANN. The elements give the best possible agreement with the whole collection of observations.

(To be Continued.)

STELLAR PHOTOMETRY.

BY HENRY M. PARKHURST.

Early in my endeavors to devise means for the accurate determination of the relative brightness of stars, certainly as early as 1859 I was confronted with the disturbing effect of the illumination even of a darksky, which increased in the moonlight and in the twilight. With the same aperture, and therefore with the same amount of light from a given star, its apparent brightness is much increased by increasing the magnifying power; and fainter stars become visible. From an examination of my star-maps I ascertained, in 1860, that reducing the magnifying power from 96 to 27 made a difference of about a magnitude in the visibility of stars. From a series of observations in 1875, I ascertained that magnifying power of itself does not affect the apparent brightness of stars, and does not tend to bring to view fainter stars; but that the observed effect is solely due to the darkening of the field by spreading its light over a larger surface. I ascertained this by the following means:

I mounted my six-inch object-glass outside of the telescope tube, and also a holder for eye-pieces. It was then easy, in looking at stars through that, or any smaller aperture, to admit light from around the object-glass sufficient to make the illumination of the field the same, whatever magnifying power was employed. When that was done with a series of eight eye-pieces, there was no difference in the visibility of faint stars which could be attributed to magnifying power.

A little reflection showed that the bringing to view of fainter stars being due solely to the darkening of the field, the diminution of the aperture tends to bring to view relatively fainter stars; for instance, if the aperture is diminished one half in area, a star must be twice as bright intrinsically to give as much light at the focus of the telescope; but the field being darkened by the diminution of the aperture, stars less than twice as bright will be visible. The amount of this effect can be approximately ascertained from the determination in 1860 already referred to. Raising the magnifying power from 27 to 96 corresponds in the illumination of the field, with the reduction of the aperture in that ratio. To the effect of this reduction, which would be 2.7 magnitudes, is to be added the difference of about one magnitude from the difference of illumination, which will be required to extinguish the star, making the measured difference 3.7 magnitudes; in other words, the scale is extended, between these limits, about one-third.

This was not varied by extinguishing the pencil of rays near the eye-piece; for although a large part of the field would remain bright, there would be a darkening of the field on the side where the stars were extinguished, and the background upon which the star is last seen is precisely as much darkened as if the pencil of rays had been reduced in the same proportion by diminishing the aperture of the object-glass.

The same principle is evidently applicable to the use of the wedge for extinguishing the star. As the star passes the transit wire, it is seen projected upon a field of a certain brightness. It passes behind the wedge, and is constantly passing into a darker and darker field. The star's light must be reduced by four magnitudes (using for convenience this rough approximation) to reduce its visibility by three magnitudes. But we have no means of determining directly how much the star's light is diminished by the wedge; we can only determine how much its visibility, as affected by illumination, is reduced. So that if we have a correct standard of comparison, and

neglect for the present second differences, the varying illumination will not introduce any error into our results, provided the illumination is the same when we make our observations as it was when the scale was determined.

But suppose that we determine the scale by comparisons with a dark sky, and that we subsequently make observations with full moonlight, or a brief twilight; how will that affect the results? That depends upon the law of extinction from illumination, upon the investigation of which I have spent a great deal of time, and made many thousands of observations, without reaching satisfactory results. But I will assume certain numbers for convenience in illustrating the principle: and it will be seen that they can be varied exceedingly without affecting the argument.

Suppose we start with an illumination barely sufficient to affect the retina perceptibly, extinguishing .01 magnitude; so that a star appears .01 magnitude fainter in consequence of that illumination than it would if there were absolutely no illumination.

First, let us diminish the illumination. We reduce it 5 magnitudes, or one hundred fold. This can only reduce the extinction by .01 magnitude; and if we were to reduce the illumination 5000 magnitudes we could not reduce the extinction any more.

Next let us increase the illumination one hundred fold, or 5 magnitudes. Starting with .01 magnitude extinction, one hundred times the illumination, while it will not produce one hundred times the extinction, may produce ten times, or .1 magnitude. Increasing the illumination again one hundred fold, it will be pretty safe to say that the extinction will have increased to a whole magnitude.

Now suppose a 12th magnitude star is just visible through the thin edge of the wedge while *Polaris*, a 2nd magnitude star, is visible at the thick edge. The apparent light must be reduced 10,000 times by the wedge between these two points.

The light of the sky must be reduced in the same proportion. If at the thin edge the light of the sky is only sufficient to reduce the star by .01 magnitude, there will be no appreciable difference between the extinction of the two ends of the wedge: it cannot exceed .01 magnitude.

But, on the other hand, suppose that in consequence of a bright moon or twilight, the light of the sky is sufficient, even at the back end of the wedge, to produce an extinguishing effect of .01 magnitude. In that case it is evident that at the thin edge, where the illumination is 10,000 times greater, the effect must be very considerable; perhaps exceeding the amount suggested above 1.0 magnitude. The scale of the wedge having been determined with the dark sky first assumed, there will evidently be introduced a very appreciable difference of scale with the bright sky last assumed.

I understand Prof. PICKERING to believe that in the observations of Prof. PRITCHARD with the wedge, there are to be found evidences of such a change of scale from varying illumination. The amount of the variation is not yet important; but its existence, for I understand Prof. PRITCHARD to claim that the constancy of his observations of *Polaris* proves that if there is any error at all, it is inappreciable.

I regret that he did not group his observations of *Polaris* in a more satisfactory way. With the light of the full moon taken as unity, the average light of the second and third quadrants is about .373, while the average light of the first and fourth quadrants is about .026; but if he had divided the circle into four parts, so as to bring the full moon into the center of one of the parts, the average light of the full moon period would have been .599, of the first and third quarters .096, and of the new moon period only .007. Such a grouping would have shown much more plainly any effect of the moon's illumination.

But taking the figures as he gives them, and admitting that the difference is not greater than the ordinary errors of observation; what does that prove? Simply that the effect of the

moonlight in the thick part of the wedge, where the light of a 2nd magnitude star is reduced to invisibility, is inappreciable. That is just where we should expect the effect to be the least; it is where the effect of the moonlight is reduced 100 times less than its effect in observing a 7th magnitude star through a thinner part of the wedge.

I have recently made some observations directly bearing upon this point. In a certain group of stars, I found two of such relative brightness, that in observing with a dark sky, the brighter through a shade and the fainter without it, the magnitudes were almost precisely equal, measured photometrically. Several days before full moon, when its light was .25, the brighter star seemed about as before, but the other had become too faint to measure. I then compared the brighter, seen through the shade, with a third star seen without it; and the result was, allowing for the known difference in the magnitudes of these two comparison stars, that the fainter star was extinguished 1.2 magnitudes more than the star seen through the shade. The observations of the brighter star through the shade, corresponded with an observation through the thicker part of a wedge, while the observations of the fainter stars corresponded with observations at the commencement of the wedge; the difference of 1.2 magnitudes caused by the moonlight corresponding with the error which would be produced by the same amount of moonlight in comparing the same stars with the wedge, the scale having been determined in a dark sky.

These considerations and observations suggest two precautions in the use of the wedge: 1st, that there shall be no moonlight or twilight sufficient to cause an error appreciably increasing the error of observation; and 2nd, that the scale shall be determined with the same magnifying power used in the observations.

It has been suggested that the three observations upon which so many of the determinations in the Harvard Photome-

try are based, are insufficient to give a result as accurate as is desirable. Admitted: yet it may be better to have observed 4000 stars with three observations each, than 2000 with six observations each. In the latter case each individual star would be better determined; but in most cases the object will be to compare some new star with *Polaris*. If it is compared by three observations with each of four of the H. P. stars, it is nearly equivalent to twelve observations with *Polaris*; and six observations each, of two stars previously determined by six observations each, would give no better result. We have then in the Harvard Photometry, the means of multiplying *ad libitum* our comparisons with *Polaris*, by the aid of stars in the same part of the heavens as the star we wish to measure.

All methods of stellar photometry founded upon extinction by diminished aperture, involve the question of diffraction; which opens a field broad enough to be reserved for another article.

VARIATION IN THE NEBULA OF ANDROMEDA.

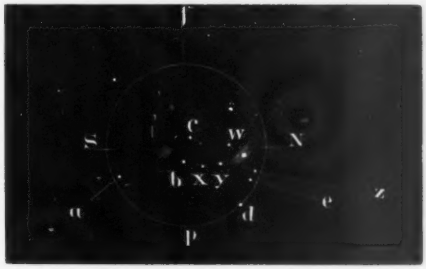
W. H. NUMSEN.

The remarkable variation in the great nebula in *Andromeda* was duly observed immediately upon receipt of the news. On Sept. 1st it was watched at intervals for about three hours, from $8^h\ 30^m$ to $11^h\ 15^m$ (75th meridian time) in company with several others at the observatory of another. Its brightness, during the interval, I estimated at about the 5th magnitude by a rough comparison with ν *Andromedæ* ($4\frac{1}{2}$), but on the next night, at my own observatory, I came to the conclusion that this was an overestimate, for a careful comparison with D. M. $+39°,158$, convinced me that it was no brighter than 7th magnitude. The nucleus, however, was very sharp and distinct, standing out clear from the surrounding bright nebulosity, and while, in this sense, it was stellar, yet there was something about it that did not impress itself upon me as a real star point. This, however, may have been due to its being seen through the

nebula. The intrinsic brightness did not seem to equal that of a star, and it rather resembled the appearance of the stellar nucleus that formed so suddenly in the Pons-Brooks comet, and which was seen by me on the night of January 13th, 1884. The observations below were made with my 4-inch Cooke equatorial.

The comparison stars were identified after each observation by means of the Durchmusterung maps, a diagram being made at the telescope at the time. The magnitudes appended are those found in the "Bonner Sternverzeichness—Zweite Section." At the end of each observation, is given the approximate magnitude, as estimated by me from the comparisons with the D. M. stars.

Sept. 2nd.—8*h* to 9*h* 15*m*. Clear, 60. Stellar nucleus about the same as last night. Certainly not as bright as HEIS 85=32 Flamsteed, 5½ magnitude according to the "H. P." (This star was identified afterwards by means of HEIS' Atlas. It was also seen to be brighter than nucleus last night, but not having my maps at hand, its name and magnitude were not known. Nucleus about equal to *a*, brighter than *b*. Perfectly stellar and sharp again. 7th.



Nova and Companion Stars.

Cloudy weather and illness prevented any further observations until the 9th, except on 6th, when it was observed with an opera-glass from my window. It was then seen to be fainter than HEIS 85, and thought to be more easily seen than D. M.+39°, 158.

Sept. 9th:—11*h* 45*m* to 13*h* 15*m*. Cleared up and bright—p. 60. Undoubtedly fainter since last seen with telescope. Seems brighter than *b*, and fully equal to *c*, and perhaps slightly brighter. Appears dull though still very distinct from balance of nebula. 9th.

Sept. 12th:—7*h* 20*m* to 9*h* 40*m*. Clear, crescent *Moon* for awhile. Not certain about seeing it with finder, but with p. 25 and 60 it is still plain and distinct. Appears fully as bright as *b* or *c*, intrinsic brightness seems also about equal to those stars. At times think nucleus slightly brighter, perhaps, but it is certainly as bright. 9th.

Sept. 14th:—7*h* 30*m* to 8*h* 20*m*. Clear, *Moon* near first quarter. Not always evident with p. 25, sometimes blurred, better with p. 60. When steadily seen generally appears perfectly stellar. Sometimes think almost equal to *b* and *c*, but generally not as bright. *Much* brighter than *x* and *y*, and more nearly equal to *d*. 9¼.

Sept. 15:—7*h* 40*m*. Seen for only five minutes or so between clouds. Quick comparisons with *d* seemed to make it about same as last night, possibly very slightly fainter, though not enough time to satisfy myself upon this.

(To be Continued.)

EDITORIAL NOTES.

The new variable star in the great nebula of *Andromeda* still continues to be a celestial object of great interest to every astronomer at home or abroad. For more than two hundred and seventy years this nebula has been observed by the telescope, and yet very little progress has been made in learning its physical constitution. "Its spectrum is continuous without transversal dark lines, and consequently the substances which compose it remain unknown. The highest powers have shown 1500 stars in it, but it is not certain that these stars belong to it; they may be simply before it. Its shape alters strangely according to the power employed."

As stated last month, the first intelligence of the existence of this new star came to us from Mr. J. C. McClure, of Red Wing, Minn., who observed it on the evening of August 27. Mr. H. S. Moore, of Texas, saw

it September 30th. Dr. HARTWIG, of Dorpat, observed it August 31st and immediately reported the observation by telegraph to astronomers everywhere, so that on the first days of September it was very generally observed.

The exact date at which the outburst took place, (if sudden, or comparatively so) is not known. The record of observation, however, is nearly continuous for the month of August. On the 18th day of that month, as reported by the *Observatory*, a Mr. SLICOCK observed the nebula and was sure that the star was not then seen. At 11 o'clock P. M., August 19th, ISAAC W. WARD reports a new star distinctly visible. On August 22nd this observation was confirmed by others made in Russia It is very probable then, that this wonderful change took place either on the 18th or 19th day of August, and that the star was brightest abo u ugust 31st, or Sept. 1st, at which time English observers claim that its magnitude was 6.5. Sept. 2nd and 3rd it was 7.3, with little change in magnitude. From this time the star declined rather unsteadily, alternately rising and falling, until Sept. 18th its magnitude was 9.2 and at the end of the month it was certainly below an eleventh magnitu de.

The star is of an orange yellow tint.

It is difficult to determine its spectrum because of its unfavorable surroundings and its faintness. Reports that have been received are so conflicting that little confidence is felt in conclusions based on the observations of the spectroscope.

The most that can be said is that the spectrum is continuous, which of course gives no knowledge of present physical conditions of the *nova*. The following points, gathered from American observers of experience may be of interest to our readers:

1. The star does not in any way affect the structure or brightness of the surrounding nebula.

2. It stands apparently only in accidental relation to the nucleus of the nebula. It is not *in* the nucleus, but about 15″ one side.

3. It has not changed its position since its appearance.

4. Its spectrum was on Sept. 1st and 2nd as nearly continuous as that of any star known to our most experienced American observers.

OBSERVATIONS OF THE NEW STAR IN THE NEBULA OF ANDROMEDA.

News of the outburst was received at Princeton in the afternoon of Sept. 1, by telegram from Cambridge, and observations were made the same night.

The star, as seen in the 23-inch equatorial with the 'comet eye-piece' (power 110) was of a brilliant orange color, and much brighter than any-

thing else in the field of view, which is about 28′ in diameter. It was adjudged about half a magnitude fainter than the star ARGELANDER 39° 158, which is given as 7th magnitude; but no photometer readings were taken. It was easily visible in the 2-inch finder. In the 5-inch finder it was of course conspicuous, and by close attention, the old nucleus of the nebula could be seen, just to the east of the new star, but nearly overpowered by it.

With a power of 360 on the great telescope, the nebula was seen to retain its familar form and appearance, unchanged, except so far, of course, as the introduction of a fiery spark into such a luminous haze would necessarily modify it subjectively. The contrast between the ruddy, sharply-defined star, and the indefinite, hazy, yellowish-green glow of the nucleus was very beautiful.

A set of micrometer measures was made, to determine the distance of the new star from the little 11th magnitude star which follows the nucleus about 11s, nearly on the parallel. They gave, position angle 262° 34′, distance 109.3″. Another set on Sept. 2nd gave, 262° 36′ and 109.6″ (No correction for differential refraction yet applied.)

The distance from the star to the brightest part of the nucleus is about 14.5″—but no accurate measure was attempted, because it is impossible to set the wire with much precision on the nucleus, which loses its definiteness under any adequate magnifying power.

Most of the time on September 1st was spent in trying to make out the spectrum of the star. Various forms of instrument were used, and all agreed in showing simply a continuous spectrum in which we could make out no lines or bands of any kind; but it was abnormally weak in the blue portion. I do not mean to say that there were no lines or bands present; only that if they existed at all, they must have been very faint and hard to see, for we expected to find them, and looked for them carefully. The dark lines in the spectrum of the 7th magnitude star, before mentioned, came out well with the same apparatus.

With a power of 1100 the star was still a star, as sharp as any of the neighboring stars, while the nebula nucleus had become a mere diffuse glow of light.

Subsequent observations have added very little. The star has maintained its position unchanged, but has grown gradually fainter, though not without fluctuations, and sometimes slight increase of brightness. Since Sept. 12th we have made photometric comparisons on seven nights with the 9th magnitude stars, ARGELANDER 39,145 and 149, using a wedge photometer. At the last observation the new star was at least half a magnitude fainter than either of them.

On September 18th the new star was nearly a quarter of a magnitude *brighter* than on the 17th or 25th, the next preceding and following observations.

On September 7th, when the new star was about 8.2 magnitude, we,

for a while, thought that the small round nebula, M. 32, just south of the great nebula, was sympathizing in the excitement. Both in the 5-inch finder, and with powers up to 300 in the great telescope, its nucleus looked exactly like a star of the ninth magnitude; with powers exceeding 500, however, the stellar appearance was lost, and we concluded that probably the imagined change was imaginary only.

Princeton, N. J., Oct. 5, 1885. PROF. C. A. YOUNG.

Astronomers have watched with interest the work of Dr. WILLIAM HUGGINS, of London, and other English physicists who have been studying the solar corona by photography, during the last two years, without the favoring circumstances of a total eclipse. From results obtained it seems evident that real progress has been made in the solution of this, one of the most difficult and delicate problems known to solar physics.

During the early part of this year, however, Professor W. H. PICKERING of Boston made some attempts to photograph the corona of the *Sun* under similar circumstances which were unsuccessful.

He said in *Science* (August 14, 1885): "The result of my researches, seems to indicate 1st, that without a total eclipse it ought to be impossible to photograph the solar corona; 2nd, having tried, I have failed to photograph the corona, but have obtained the result which theory indicated."

To the paper containing the result of Prof. PICKERING'S work, Dr. HUGGINS replies, the following being a letter addressed to *Science* and THE MESSENGER, October 2, 1885.

"Mr. W. H. PICKERING having courteously sent me a copy of *Science* (August 14) containing a letter entitled "An Attempt to Photograph the Solar Corona without an Eclipse" may I ask you to insert the few lines which follow, in the next number of your journal?

Passing by all those points which are covered directly or indirectly by my reply to Mr. PICKERING'S first letter (*Science* April 3) I find only two matters which I consider it necessary to notice.

1. Mr. PICKERING says: "The inferiority of the best gelatine plates to the human eye in this respect (small differences of light) is very readily shown by an attempt to photograph distant mountains." He then goes on to say: "Another illustration of the same thing is the impossibility of photographing the *Moon* in the daytime when the *Sun* is high above the horizon. Although the *Moon* may be perfectly distinct to the eye, the negative shows no trace of it."

To your scientific readers the reasons will readily suggest themselves why in the case of the *Moon* in the daytime at some angular distance from the *Sun* the eye has an advantage over the plate, while in the case of the corona the plate has a great advantage over the eye. Next, from any such considerations, as a matter-of-fact, *there is no difficulty in photographing the Moon at noonday.* Yesterday I took with the apparatus

used on the corona four negatives on bromide plates (EDWARD's) between 11:30 a. m. and noon in full sunshine. On all the plates the *Moon* is very distinct and well defined. The *Moon* at noonday, unless too near the *Sun* is an easier object to photograph than the corona. It is obvious, therefore, that photographic methods which are not delicate enough for the *Moon* must utterly fail if applied to an object still more difficult, as the corona undoubtedly is at ordinary elevations.

If Mr. PICKERING's statement of the "impossibility" of photographing the *Moon* under the conditions already named rests upon his own experiments, some light may come upon a point which has occasioned me surprise, namely that Mr. PICKERING does not appear to get upon his plates, the effects of his own apparatus; for example those of the position of his shutter, and those of his spectacle lens. In some experiments I made with a shutter, similarly placed, very strong diffraction effects appeared on the plates; effects stronger than any photographic action which could be supposed to be due to the corona.

2. With regard to Mr. PICKERING's experiments, I would point out that the conclusion to which they lead him, namely:—"It therefore seems that even in the clearest weather the reflected light of the atmosphere is 300 too strong to obtain the faintest visible image of the true coronal rays;" appears to me to be irreconcilable with the direct observations of Prof. LANGLEY and others, of the planets *Mercury* and *Venus* as black disks before they reach the *Sun*. Prof. YOUNG says: "Of course this implies behind the planet a background (of corona) of sensible brightness in comparison with the illumination of our atmosphere.—[*The Sun p. 229.*]

I trust that Mr. PICKERING will not think me wanting in courtesy, if I should prefer not to take notice of any further communications he may make on this subject. The Bakerian lecture, read recently before the Royal Society, in which I have discussed some of the points more fully will be in print in a few weeks. The photographic method is now being tried at the Cape of Good Hope under the scientific conditions I have pointed out as essential by Mr. RAY WOODS under the able superintendence of Dr. GILL, F. R. S."

PARALLAX OF 61 CYGNI.

In Dunsink observations (V) Prof. BALL gives a history of researches on the *parallax* of this star. In 1837—38 BESSEL found a parallax of 0.314″, using two comparison stars, D. M. 37°, 4173 (8.8 mag.) and D. M. +37°, 4179 (8.6 mag.) In 1853 O. STRUVE found the parallax to be 0.509″ using D. M. +37°, 4345 (9.4 mag.) Dr. LAMP has re-reduced this and finds $-0.5063'' \pm 0.0234''$. In Moscow observations, VII, p. 79 is a series of measures by SCHWEIZER with the latter comparison star extending over the years 1863—1866. These have been reduced by SOCOLOFF, who finds parallax $= 0.4330'' \pm 0.0291''$. Dr. LAMP has re-computed this and

finds 0.4396″ ±0.0223″. Dr. BALL made a series employing D. M. +37°, 4351 (9.5 mag.) and 61 A *Cygni*. The resulting parallax was 0.4654″ ± 0.0497″ (Dunsink, III p. 16). Dr. BALL made another series in 1878—79, using 61 B and D. M. 4351. The resulting parallax is 0.4676″ ±0.0321″. Prof. HALL (Wash. Ast. Obs. 1879) has used the same comparison star as STRUVE (D. M. 4345) and finds the parallax of 61 B *Cygni* to be 0.4783″ ± 0.0138″.

C. A. F. PETERS from absolute I. D. gives (1846)—0.359″.

Dr. AUWERS (Abh. d. Acad. Berlin 1868) has re-discussed BESSEL'S and SCHLUTER'S results. The following Table is taken from Dr. AUWERS and SCHLUTER:

BESSEL: first 14 months	0.357″
" last 3 months and SCHLUTER	0.536
JOHNSON: first 3 months	0.526
" last 1 month	0.192
STRUVE:	0.511
AUWERS	0.564

ON THE BRIGHTNESS OF THE NEW VARIABLE STAR IN ANDROMEDA.

The method followed in the observations of this star was that proposed by Prof. PICKERING in his "Plan of securing Observations of the Variable Stars," p. 12. It consists in estimating the brightness of the variable in tenths of the interval between two comparison stars, one slightly brighter, the other slightly fainter than the star to be measured. The number of tenths estimated is written between the letters of the comparison stars, that of the brighter standing on the left side, and smaller numbers indicating greater brightness.

The instrument employed is a 3-inch telescope by MERZ. The observations were made by two observers: H=HAGEN and Z=ZAISER, the latter being assistant at the observatory.

In order to facilitate the comparision of our observations with those of others, the following Table I exhibits the places and magnitudes of the four comparison stars, *A*, *B*, *C*, *D*, to which are added the three comparison stars, *b*, *c*, *d*, employed by Mr. E. E. BARNARD, as represented in his sketch, page 241 of the MESSENGER. His observation of September 3 is a valuable addition to the following series of magnitudes, and is given below in Table II, under the letter *B*.

TABLE I.

Comparison Stars; position and magnitude taken from the D. M. (1855).

A	0h 38m 6.7s	+40° 0.8′	magnitude 7.5
B	37 45.2	23.5	9.0
C	36 54.2	30.8	9.0
D=b	36 9.7	40 46.9	8.9
c	34 9.5	39 53.6	7.0
d	36 11 3	38.0	8.0

TABLE II.

Date	Central Time	Observations	Remarks	Obs.	Reductions.	Mags.
Sept. 3.5		*c* 5 *b*, *c* 10 *d*		B.	8.0	8.0
9	9h 16m	*A* 8 *B*	Sky clear	H.	8.7	
10	8 10	*A* 7 *B*, *A* 8 *D*	Very clear	H.	8.6	8.6
13	8 7	*A* 8 *B*, *A* 9 *D*	" "	H.	8.7	8.8
14	9 50	*A* 9 *B*, *A* 10 *D*	" "	H. Z.	8.9	8.9
15	9 28	*A* 9 *B*, *A* 9½ *D*	Moonshine	H. Z.	8.9	8.8
16	9 0	*A* 8 *B*, *A* 9 *D*	"	H.	8.7	8.8
		A 8½ *B*, *A* 9 *D*		Z.	8.8	8.8
17	9 33	*D* 1 *B*	Clear	H.	8.9	
	9 43	*A* 9 *D*		Z.	8.8	
18	9 27	*D* 1 *B*	Cloudy	H.	8.9	
19	8 35	*D* 1 *B*		H.	8.9	
		D 2 *B*		Z.	8.9	
20	8 46	*D* 10 *B*	Moon very bright	H.	9.0	
		D 9 *B*	" " "	Z.	9.0	
21		*D* 10 *B*	" " "	H. Z.	9.0	
22	8 36	*B* 10 *C*, *D* 10 *C*	" " "	H.	9.0	

On September 23, 24, 25, 26, the star was observed less than C, i. e. less than 9.0 mag. From October 1, it was entirely invisible with power 30, i. e. less than 9.5 mag. Each observation is reduced separately for the sake of comparison. The reductions, however, being based on the magnitude of the Durchmusterung, are only preliminary, and may easily be transferred to the photometric scale of Harvard College Observatory, as soon as the comparison stars have been subjected to a new determination with the photometer. J. G. HAGEN, S. J.

College of the Sacred Heart, Prairie du Chien, Wisconsin.

OCCULTATION OT THE HYADES, OBSERVED AT WILLIAMSTOWN, MASS., ON SEPTEMBER 28TH, 1885.

The following observations of occultations of stars in the *Hyades* group were made at the Hopkins Observatory of Williams College:

Star	Phase	Williamstown M. T.
D. M.+15,621	Emersion	9h 54m 47.0s
Theta[1] *Tauri*	Immersion	10 13 51.7
Theta[2] *Tauri*	"	10 21 8.3
Theta[2] *Tauri*	Emersion	11 1 56.3
Theta[1] *Tauri*	"	11 8 40.0
D. M.+15,633	"	11 25 57.8
B. A. C. 1391	"	12 12 10.7
D. M.+15,640	"	12 17 10.9
Alpha *Tauri*	Immersion	13 57 13.0
" "	Emersion	15 15 5.4

These observations were made with the Clark equatorial of 7½-inches aperture, using a power of 120 for the immersions and a power of 77 for the emersions. The times were noted by a mean time chronometer, beating half seconds, whose error was determined by careful comparison

with the sidereal clock at the Field Memorial Observatory, both before and after the observations. Prof. T. H. SAFFORD determined the error of the sidereal clock by observation with the Wanschaff transit, the resulting correction being reduced to the meridian of the Hopkins Observatory, which is 1.52*s* east of the Field Observatory.

The atmosphere on this night was remarkably steady, and, so far as I could judge, the disappearance and re-appearance of the stars were absolutely instantaneous. The immersion took place at the bright limb.

I must here express my acknowledgements to Prof. SAFFORD for his courtesy and kindness in placing the facilities of the observatory at my disposal, and thus enabling me to make these interesting observations.

The working list was formed by plotting the *Moon's* apparent path and the places of the neighboring stars, and deducing from the plot the times of immersion and emersion, and the position angles for each phase.

HOOSAC FALLS, N. Y., 5th Oct., 1885. JOHN TATLOCK, JR.

NEW STAR IN ANDROMEDA NEBULA.

"While engaged in making some miscellaneous observations this evening my attention was particularly directed to the great nebula in *Andromeda*, the central part of which, always bright, seemed very much brighter than ever before.

In fact the center of the great nebula seems now to be occupied by a well-defined star which I estimated to be of the 6th or 7th magnitude.

The fainter portions of the nebula are not nearly so well-defined as as if the light of the nebula were overpowered by that of the star.

The object thus seen is surely a star, inasmuch as with powers of 40, 80, 135, 200 and 300 the star like disk was clearly and sharply defined The star-like character was also plainly indicated in the finder. Can it be that we have here a solution of the mystery of this nebula as indicated by the spectrum observations of Dr. HUGGINS who found a continuous spectrum cut off at the red end. It has long been a mooted question whether the nebula of *Andromeda* was stellar or gaseous.

Should the object seen by me prove to be in fact a star will it be classed among the "variables" or take permanent rank as another nebulous star, or will it fade into star mist like the new star in *Cygnus* in 1876? At all events it deserves to be carefully watched."

HENRY A. PAVEY.

[NOTE:—The above recorded observation was made by me on Sunday night, August 30th, 1885, from 9 o'clock p. m. to 11 o'clock p. m. at Hillsborough, Ohio.]

Letter to the Editor from Professor EDWARD S. HOLDEN, *relating to the Lick Observatory and to the Washburn Observatory.*

MY DEAR SIR:—

The Lick Observatory is a gift from Mr. JAMES LICK to the State of California. t is to be built and completely equipped under the direction of the Board of Lick Trustees, of which Captain RICHARD S. FLOYD is President. The Observatory, when completed, and the unexpended balance of the original fund of $700,000 are then to be turned over to the Regents of the State University of California as the Astronomical Department of the University. I have beeen elected President of the University of California and Director of the Lick Observatory and I shall assume these new duties about January 1st, 1886.

May I ask, through your columns, that letters and parcels destined for me personally should be directed to me at Berkly, California, (the seat of the University), while parcels for the Observatory should be addressed:

Library of the Lick Observatory,
San Jose, Santa Clara County,
California.

I desire to thank the many astronomers and societies who have generously added to the library of the Washburn Observatory by their gifts, and to ask of them a similar generosity to the Lick Observatory, where a large library is forming.

Real astronomical work at the Lick Observatory will begin as soon as it is possible. Under the provisions of the Trust, no salaries can be paid to observers until after the completion of the Observatory; and this date depends upon the time at which the large telescope is finished by the firm of A. CLARK & SONS. Everything else is practically complete.

I have hopes that some arrangement may be made by which the meridian circle and the 12-inch CLARK refractor may soon be put to use. The Washburn Observatory will shortly print its Volume IV, containing as many of the observations of the 303 fundamental stars as I have been able to make since May, 1884, when this work was begun.

I am, my dear Sir, very faithfully yours,

EDWARD S. HOLDEN.

WASHBURN OBSERVATORY, University of Wisconsin, Madison, October 20th, 1885.

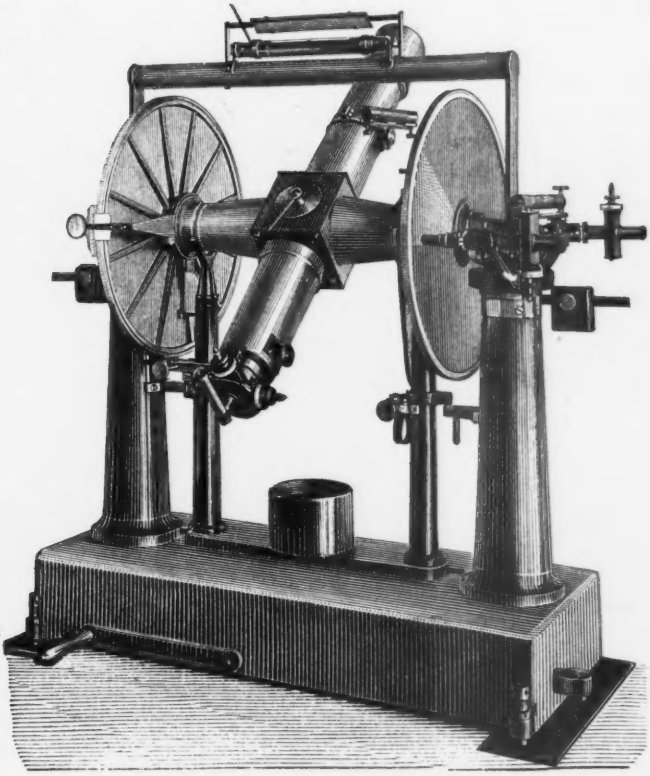
WEIGHT OF LARGE OBJECT-GLASSES.

The glass in the cell for the 30-inch Pulkowa refractor weighs 428 pounds. If the weight of the 36-inch objective for the Lick Observatory increases proportionally, its weight will be 740 pounds. These are heavy weights to handle.

FAUTH & CO.

ASTRONOMICAL WORKS,

WASHINGTON, D. C.



TRANSIT CIRCLE.—4 inch objective. 16 inch circles.

EQUATORIALS, TRANSITS, MERIDIAN CIRCLES,

ASTRONOMICAL CLOCKS, with Break-Circuit Arrangement.

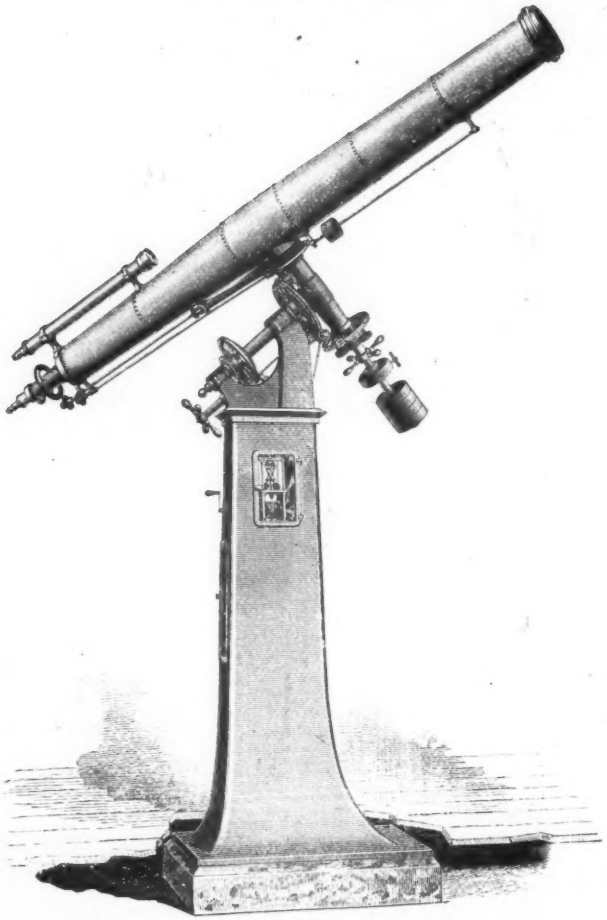
CHRONOGRAPHS

Level Vials reading to single seconds; Eyepieces of all kinds, Micrometers, Spectroscopes, and Astronomical outfit of every kind. Also all kinds of instruments for higher Geodesy and Engineering purposes.

SEND FOR NEW CATALOGUE.

WARNER & SWASEY.

Astronomical Outfits.



EQUATORIAL, 9½ inch Aperture.

Equatorials from six inches aperture to the largest size. Improved Chronographs, Driving-Clocks, etc. Domes of all sizes with patent anti-friction running gear and shutter.

Correspondence Solicited,

WARNER & SWASEY, Cleveland, O.